

First Report of a Humeral Fracture From Pitching After Latissimus Repair

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Overhead athletes, specifically baseball pitchers, place a tremendous amount of stress on their arms during the throwing motion; this can lead to a variety of injuries.¹² As fastball velocity continues to increase, injuries to the latissimus dorsi (LD) and teres major (TM) have become increasingly common in high-level baseball pitchers.^{3,5,10,13} Because the primary role of the LD and TM is humeral extension, adduction, and internal rotation, these injuries often occur during the deceleration/follow-through phases of the throwing cycle, when the LD/TM attempts to slow the arm down.

While some LD/TM injuries in high-level baseball players can be managed nonoperatively, players with higher grade injuries, typically grade III and grade IV tears, often do well with surgical repair.^{3-5,8,10,13} Complications after surgical repair, to this point, have been rare and relatively minor.^{3,5} We present the case of a professional baseball player who underwent successful LD/TM repair for grade IV tear and subsequently sustained a spiral humeral fracture emanating from the inferior drill hole

used to insert a unicortical suture button after he returned to pitching at 12 months postoperatively.

CASE REPORT

The patient was an otherwise healthy 31-year-old male professional baseball player who had felt an acute pop in his arm when throwing a baseball 2 weeks before presentation. He had no prior shoulder or elbow injuries. On initial presentation, he had complained of a deformity in his posterior axillary fold. There was tenderness to palpation over the LD tendon. He had normal shoulder range of motion and strength. Initial radiographs were unremarkable (Figure 1). A magnetic resonance image demonstrated a grade IV injury to his LD/TM (Figure 2).⁴

The patient elected to undergo surgical repair. The repair technique involved placing the patient in the lateral decubitus position with the assistance of an arm positioner (Trimano; Arthrex), which was placed on the opposite side of the operating table. A curvilinear skin incision was made in the posterior axillary fold, and dissection was taken down to the avulsed LD/TM tendon (Figure 3, A and B). Once the LD/TM were mobilized, the posterior aspect of the humerus was carefully exposed, taking great care to protect the surrounding neurovascular structures. The normal insertion of the LD/TM onto the humerus is a broad, flat insertion spanning more distance proximal to distal than medial to lateral, which must be kept in mind when exposing the native footprint. Three unicortical buttons with high tensile suture and a suture tape (Arthrex) were inserted through each button and were then placed in a stoplight configuration (Figure 3C). A 3.7-mm drill bit was used to drill unicortically, and the button was then inserted and, once intramedullary, was flipped against the humeral cortex. The sutures and suture tape were then used to reapproximate the LD/TM tendon to bone using the tension-slide technique (Figure 3D). The incision was closed in layered fashion and sealed with a skin glue.

Our patient had an uneventful postoperative course. He began his return-to-throwing program 4.5 months postoperatively and progressed through this without an issue. He

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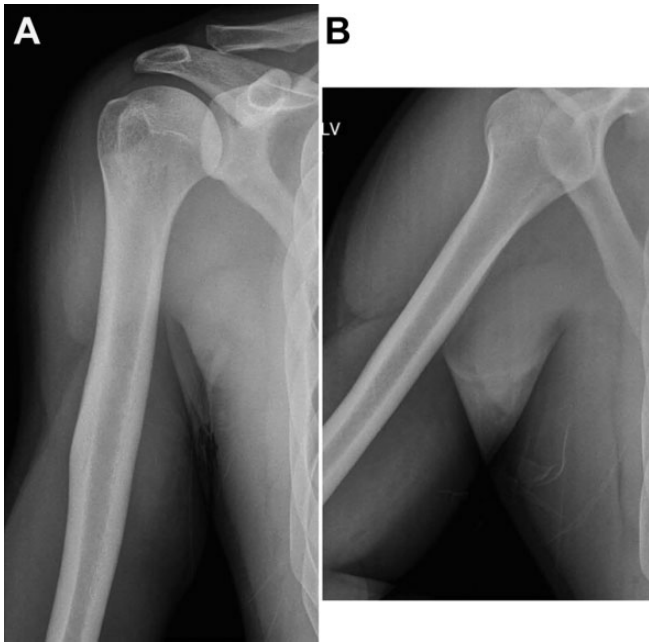


Figure 1. Preoperative (A) anteroposterior and (B) lateral radiographs.

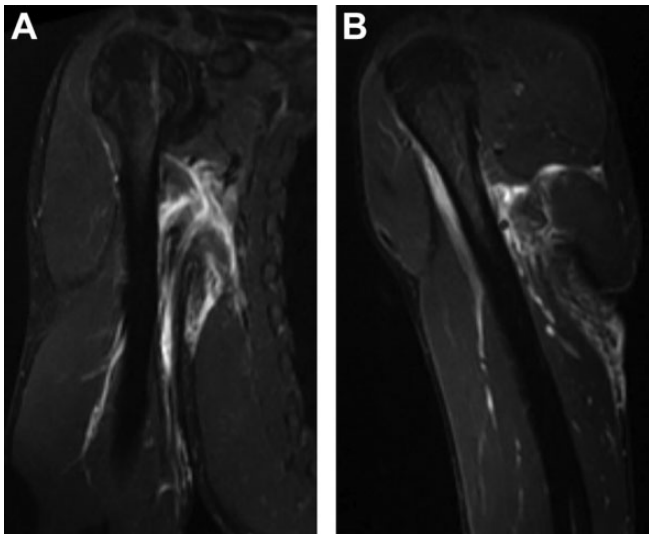


Figure 2. (A) Coronal and (B) sagittal magnetic resonance image demonstrating a grade IV tear of the latissimus dorsi and teres major tendons.

completed his return to the throwing program at 11 months and was able to reach his preinjury fastball velocity, which was 95-97 mph. During spring training, when he was 12 months out from surgery, he was throwing a maximum effort fastball when he heard and felt a “pop.” He was unable to move his arm. He was completely asymptomatic before this pitch, with no complaints of arm or shoulder pain at the site of surgical repair since his early postoperative recovery from the procedure.

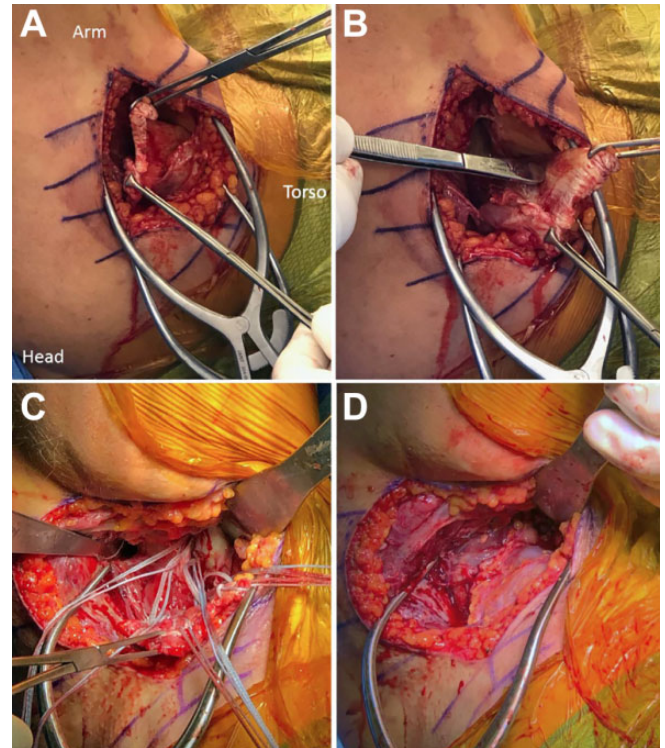


Figure 3. Intraoperative images demonstrating the complete tear of the latissimus dorsi (LD) and teres major (TM). The patient is in the lateral decubitus position. The patient’s hand is toward the top of the image and the torso is to the right of the image. (A) The superficial aspect of the LD/TM within the clamps. (B) The deep surface of the dissected tendon. (C) The sutures coming out of the 3 unicortical buttons that have been placed. (D) The final repair construct.

Radiographs demonstrated a spiral humeral fracture that originated at the inferior-most drill hole from his LD/TM repair (Figure 4). A computed tomography scan confirmed that the fracture began at the inferior-most drill hole (Figure 5). Given the fracture pattern and the patient’s desire to return to pitching, he underwent open reduction internal fixation (ORIF) of his humeral fracture with a plate-and-screw construct (Figure 6). Given the fracture location and desire to minimize any damage to the pectoralis or triceps, a posterior triceps-splitting approach was used for the exposure in this case.⁶ The radial nerve was carefully exposed and gently mobilized to allow the fixation plate to go under the various branches of the nerve.

Postoperative radiographs demonstrated anatomic alignment of the fracture (Figure 7). The patient did well in the initial postoperative period with no complications, including full function of his radial nerve. After allowing the fracture to heal for 3 months, he will be advanced to sport-specific training for his upper body, then return to light toss throwing at 4.5 months, progressing as tolerated with pitching, including from the mound at 6 months after surgery. Full return with no restrictions

and potentially achieving his prior level of performance is estimated to take 12-15 months. There are no prior studies evaluating the ability to return to prior performance of pitching after suffering a postoperative proximal humeral fracture.



Figure 4. (A and B) Radiographs demonstrating the spiral humeral fracture that begins at the most inferior drill hole for button placement.

DISCUSSION

This is the first case in the literature of a humeral fracture after LD/TM repair. The fracture originated at the inferior-most drill hole for the unicortical button that was used to repair the LD/TM to the humerus. This is an important complication to note and, although extremely rare, should now be discussed with patients who return to sports associated with repetitive movement of their surgical arm that imparts a high level of torque before they consider an LD/TM tear.

Injuries to the LD/TM have increased in recent years in high-level overhead athletes.^{3,5,8} While these injuries were historically treated nonoperatively, recent evidence has suggested that patients with higher grade injuries, specifically grade III and grade IV, have a higher rate of return to sport and better performance upon return to sport after surgical repair.⁴ Until this point, complications after LD/TM repair have been minor.⁵ This is the first report of a humeral fracture after LD/TM repair.

Fractures of the humerus in baseball players without prior surgical procedure on their arm are an uncommon but reported injury.^{1,9,11,14} Miller et al⁹ reported 3 cases of “thrower’s fractures,” in which 3 patients sustained spiral humeral fractures from pitching. None of these players had previous surgery but rather fractured their humerus from the repetitive torque placed on the bone while throwing. Ogawa and Yoshida¹¹ reported the largest series of thrower’s fractures to date, in which the authors described 90 cases of spiral humeral fractures in baseball players from throwing. These fractures occurred because of the tremendous rotational force placed on the humerus during the overhead pitch. Sabick et al¹² recorded the torque acting about the long axis of the humerus in 25 professional baseball pitchers and noted that the peak humeral axial torque averaged 92 ± 16 N·m. The authors found that the torque tended to externally rotate the distal end of the humerus

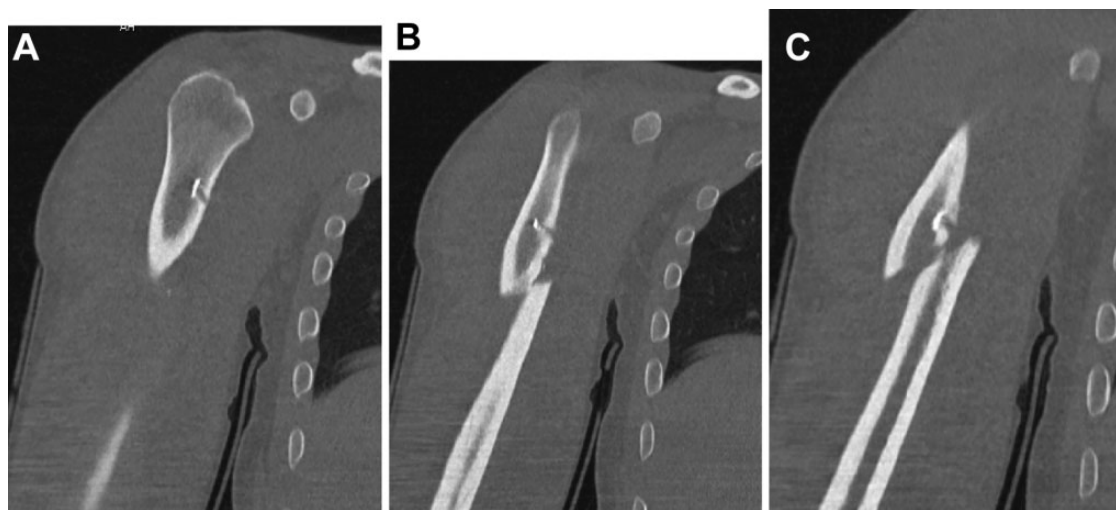
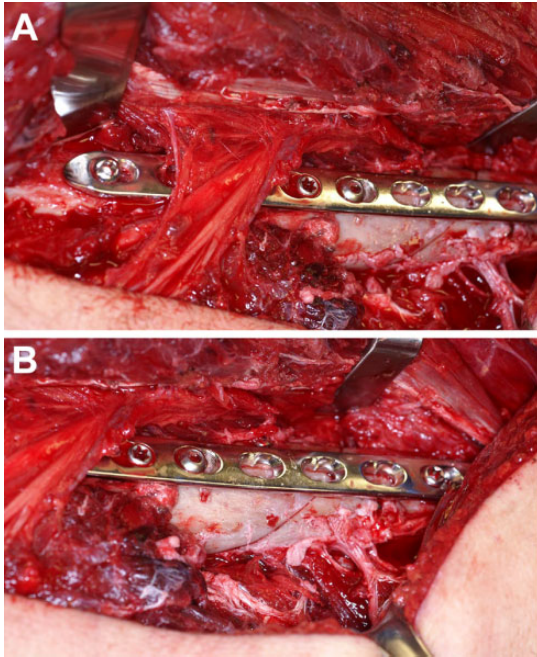


Figure 5. (A-C) Computed tomography scan demonstrating the 3 drill holes and buttons from the prior latissimus repair. The fracture line begins at the inferior-most drill hole and extends distal.



Figures 6. (A and B) Intraoperative images demonstrating plate-and-screw fixation of the humeral fracture. Notice the plate has been placed under the radial nerve.

relative to its proximal end, which is consistent with the spiral humeral fractures seen in throwers. They also noted that the magnitude of the peak humeral torque averaged 48% of the theoretical torsional strength of the humerus.

While the literature contains several reports of healthy patients who sustained spiral fractures of the humerus with no history of injury or surgery regarding the humerus, there have been fewer reports of humeral fractures arising as a complication to surgical intervention. Dein et al² reported a single case of a spiral humeral fracture in a baseball player after a proximal biceps tenodesis with use of an interference screw. In their report, the pitcher was a 46-year-old master's level pitcher who fractured his humerus 10 months after his subpectoral bicep tenodesis, which included drilling an 8-mm unicortical hole and using an 8-mm interference screw with sutures for fixation. To date, there have been no reports in the literature of a humeral fracture after biceps tenodesis with a unicortical button.

Khalid et al⁷ recently performed a biomechanical study to evaluate the torsional failure strength of the humerus after subpectoral biceps tenodesis with a unicortical button versus interference screw. The authors utilized 13 matched pairs of fresh-frozen cadavers and performed a biceps tenodesis using a unicortical button on one side and an interference screw on the other side. The authors found that the humeri fixed with unicortical buttons showed a

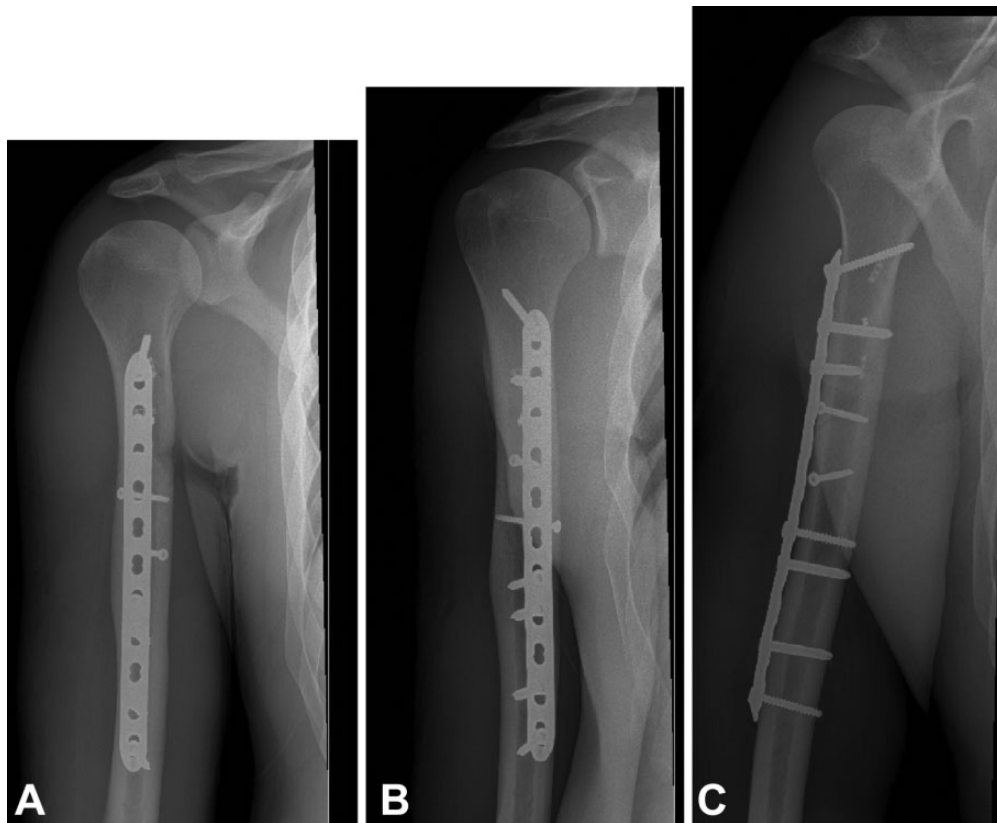


Figure 7. (A) Postoperative anteroposterior, (B) oblique, and (C) lateral radiograph demonstrating the final construct after open reduction internal fixation of the spiral humeral fracture.

statistically significantly higher rotation to failure and failure torque than humeri fixed with interference screws. Their study therefore supported the use of unicortical buttons in the proximal humerus. Of note, the drill size for the unicortical button in the Khalid et al study was 3.2-mm compared with the 3.7-mm drill used in the patient in this case study, as the unicortical buttons we use for the LD/TM repair are larger to accommodate the use of a No. 5 suture (0.7-mm diameter) and a suture tape (2-mm width) with each button.

While this complication is extremely rare, it is now a documented risk of LD/TM repair and therefore must be mitigated during surgical repair. One potential change we plan to make to our surgical technique is to use a smaller unicortical button that will allow us to drill a smaller pilot hole. The size of our drill hole is currently 3.7 mm to accommodate the larger unicortical button and stronger sutures and suture tape. In the future, the 3.2-mm drill will be used for the smaller (standard) cortical button, and the suture size will be adjusted to No. 2 (0.5-mm diameter) and suture tape (1.3-mm width). For every case, attention is focused on creating the pilot hole for these buttons centrally in the bone to avoid weakening the cortex with an oblique drill hole. Finally, another alteration to our surgical treatment protocol will include advanced imaging on our overhead-throwing patient population at 9 to 12 months after surgery, before they are released back to full return to sport, to evaluate for any reaction with the humerus.

CONCLUSION

Proximal humeral fracture is a possibility after LD/TM repair when drill holes are established for the purpose of using large unicortical suture buttons. Repetitive torque on the humerus while throwing can result in a fracture that originates at one of the drill holes, with no preceding clinical symptoms. The use of smaller unicortical buttons that require smaller drill holes for insertion (3.2 vs 3.7 mm) may help to reduce the risk of fracture. Advanced imaging with metal subtraction protocol at 9 to 12 months after surgery may potentially identify a stress reaction at the site of the cortical holes, allowing for modification of the protocol to return to full competition and avoiding humeral fracture.

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